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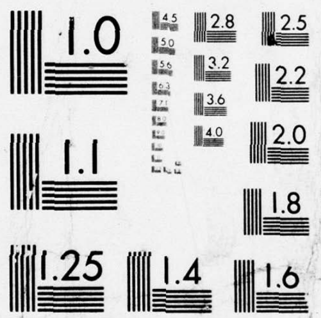
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# ONR LONDON CONFERENCE REPORT

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INCOMAT 1977—INTERNATIONAL CONFERENCE MARTENSITIC TRANSFORMATIONS, KIEV, USSR, 16-19 MAY 1977

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11 AUGUST 1977

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| MARTENSITE KINETICS | QUENCHING | PLATES |
| NUCLEATION | LATHS | DAMPING |
| TRANSFORMATION | DISLOCATIONS | |

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The third conference on martensitic transformations was held in Kiev in May 1977. This report presents a review of oral presentations made at the conference, generally in Russian, which provided a unique opportunity to learn of the extent of the Russian work in the field. Topics treated at this conference covered many aspects of martensite transformations: morphology of transformation; thermodynamics and kinetics of transformation; impact of lattice stability; wave propagation of nucleation; crystallography and structures; effects of

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deformation, dislocations, and stacking faults; shape-memory effects; and effects of stresses and strains.

# ICOMAT 1977—INTERNATIONAL CONFERENCE MARTENSITIC TRANSFORMATIONS, KIEV, USSR, 16-19 MAY 1977

"Rare opportunities for correspondence across a martensitic interface"

This Conference, which was organized by the Institute of Metal Physics of the Academy of Sciences of the Ukrainian SSR, attracted more than 200 participants from 10 countries. A total of 137 papers were presented, including 55 oral presentations (with simultaneous translation) and 82 poster reports. Of the more than 200 attendees, only 24 were from outside the Soviet Union, and although the official languages of the Conference were Russian and English, only 16 out of 131 abstracts printed in the Abstract Bulletin were in English; unfortunately, except for the titles, no written translations of the papers were provided. I am currently in the process of translating the Abstract Bulletin into English, and will provide a copy to anyone interested. The Conference proceedings will (eventually) be published, but this is likely to take at least a year, and will be 90% in Russian; therefore, a complete list of papers presented is contained in the Appendix. Only six Americans were present [Morris Cohen and Walter Owen (MIT), Gareth Thomas (Univ. of California, Berkeley), George Ansell (Rennselaer Polytechnic Inst.), David Lieberman (Univ. of Illinois), and this writer], and none of us knew even a smattering of Russian; neither did any of the Western European attendees, although some could communicate reasonably well in German, the best compromise language.

In 1976 and 1975 there also were conferences held on the subject of martensitic transformations. The 1976 conference was held 10-12 May 1976 in Kobe, Japan, organized by the Japan Institute of Metals; this meeting was called the First Japan Institute of Metals International Symposium. on "New Aspects of Martensitic Transformation," and was reported on by K. Ono in *Scientific Bulletin*, ONR Tokyo, Vol. 1, No. 2, Oct-Dec 1976. In 1975, a two-day symposium was held as part of the regular Spring meeting of AIME, in Toronto, Canada, called the "International Symposium on Shape Memory Effects and Applications." The proceedings of that conference have been published as a book titled *Shape Memory Effects in Alloys*, J. Perkins, editor (Plenum, New York, 1975).

Because of these two recent conferences on martensitic transformations, one would expect that not much in the way of new, unique, and interesting material could emerge in the short intervening period. However, if for no reason other than its location and contributors, the Kiev conference was unique. Admittedly, it was not as widely attended as the Kobe symposium in 1976; notably absent were Wayman, Christian, and a number of Japanese and American workers. However, since no Russian workers were able to come to the first two conferences, the Kiev conference provided

unique firsthand contact with Soviet researchers and their work, including many hitherto faceless names and some new ones. Such interaction had not been available since the last related conference in Russia, the 1966 All-Union crystallography meeting.

The organizing committee was nominally chaired by Academician V. N. Gridnev, director of IMPK (officially the Institute of Metal Physics of the Academy of Sciences of the Ukrainian SSR, located in Kiev*). Co-Vice-Chairmen were Dr. Yu N. Osipyan of IFSS (Institute of Solid State Physics, Moscow), and Professor L. G. Khandros of IMPK. However, major working responsibility for the meeting was assumed by Dr. Uyri N. Koval of IMPK and much work was carried out by various unsung younger members of the IMPK staff. Included in their preparatory efforts was a six-months self-administered crash course in English, because prior to this Conference none of the IMPK staff had firsthand experience with speaking English, and most had never even met an American. A four-person group consisting of Professor Khandros, his wife and co-worker Irena Arbuzova, Yuri Koval and Dr. Valery Martynov established a weekly regimen to develop their skills among themselves; considering the fact that they had no independent means to evaluate their progress, their demonstrated results were remarkable. In fact, by the end of the Conference, at least one Russian (Martynov) was observed to be listening to the Russian-to-English translation in order to further refine his English comprehension. A major problem could have been language, but was much less so for Russian attendees than non-Russian-speaking foreign guests, and was minimized by the extraordinary efforts of the Organizing Committee on behalf of the relatively low proportion of people who didn't comprehend Russian. The two simultaneous interpreters were reportedly schooled for six months in advance, with one of their exercises being to translate J. W. Christian's book, *Theory of Transformations in Metals and Alloys* (Pergamon, 1965), in its entirety, in order to become familiar totally with metallurgical and martensitic terminology.

The 24 "foreign guests," as we were referred to, were royally treated with almost no moment left without attention and/or entertainment. The organizing committee headed by Koval must be highly complimented for their extraordinary efforts.

The schedule of the technical program could not have been better. The error of the Kobe conference, parallel sessions (most inappropriate for a conference on such a narrow topic area), was not repeated. Instead, to accommodate the large number of papers, 82 were arranged into 8 poster sessions (two per day, at one-hour breaks in the middle of the morning and afternoon sessions). While these papers were almost totally isolated by a language barrier from most of the foreign guests, it was undoubtedly

*See Appendix II for a Guide to Abbreviations of the Titles of Russian Research Laboratories.

the wise thing to do in scheduling the Conference. Without prejudice to the content of these posters, this scheme saved the audience from sitting through an overly heavy schedule of oral presentations, as 131 papers at 20 minutes each would comprise more than 40 hours' time; as it was, only 20 hours were scheduled for oral presentations and discussion (2.5 hours each AM and PM), and 8 more hours for general discussion (1 hour each AM and PM), with 8 hours total for the poster sessions (1 hour each AM and PM). The poster-session intervals served simultaneously as rest and refreshment breaks, and a very well-laden table was available where meats, breads, sweets, and beverages could be purchased at very modest prices. The posters were cleverly located exactly in the center of the traffic pattern from the sessions auditorium, in the foyer of the conference-hall, and much serious attention was given them. It was, in fact, one of the most successful schemes for poster sessions imaginable, and might be wisely adopted for other conferences; the key ingredients, to repeat, were <u>timing</u> and <u>location</u> (not to mention adjacent refreshments).

Discussion was heated among the Russian contributors, who seemed to be in some kind of competition for attention and recognition. Many stepped forward during the discussion periods to present their views forcefully and to contest those of others. Many of the participants who had been relegated to the poster sessions took the opportunity of the hour-long general discussion periods to present their work orally, including complete slide presentations in some cases, and sometimes lasting 10 to 15 minutes. The typical style of address of the Russians during discussion is very robust and energetic, and the exchanges were often very dialectic, i.e., consisting of many strong criticisms, opinions, and unresolved contradictions. These exchanges were interesting to observe, but did little to shed light on the questions involved. One consistent problem with discussion was lack of identification of the individuals offering questions and comments, which together with overlooking use of the microphones (the only link with the interpreters) made it difficult to follow the discussions completely.

## OPENING SESSION

The first four presentations, by Academician V. N. Gridnev (IMPK) (nominally the opening address to the conference), Professor Y. A. Osipyan (IFSS, Moscow), Academician G. V. Kurdyumov, and Professor Z. Nishiyama (Nippon Steel Corporation, Ida, Japan), were historical and state-of-the-art reviews from their various points of view and experience, and except for Nishiyama's paper, did not reveal much truly new material. <u>Osipyan</u> presented an excellent historical review of 50-odd years of research on martensitic transformation, beginning with the pioneer work of Kurdyumov, and including interesting insights to some Russian work that is not well known and usually not credited in the West. While this paper otherwise contained little new material, it skillfully established the foundation

for the rest of the Conference by comprehensively reviewing the heritage of the field and the state-of-the-art. Kurdyumov, who before going to Moscow in 1955 was director of the local IMPK, emphasized his extensive work over the years on the effect of "doping agents" (alloying elements) on the c/a ratio and carbon redistribution in ferrous martensites, reviewing the discovery of "anomalous" c/a ratios in as-quenched martensites. Nishiyama limited his review to recent Japanese work, including (i) work by Shimizu and coworkers on the crystal structure and internal defects of Ag-47%-Cd martensite; (ii) studies by Takezawa and coworkers on reversible (two-way) shape-memory-effect (SME) behavior due to stabilization of stress-induced martensite (SIM) formed at higher temperatures in Cu-Zn-Al, behavior which is very interesting and deserves further investigation; and (iii) research by Saburi and coworkers on athermal formation of large single crystals of martensite in Cu-Zn-Ga. In this last case, Nishiyama presented unpublished polarized-light color photomicrographs indicating that the martensite crystal is a true single crystal, with no internal twins such as seen in the martensite produced by single-interface transformation in other alloys. It should be noted (tongue-in-cheek) that a unique new K-N (Kurdyumov-Nishiyama) martensitic relationship was recognized at this Conference, that symbolizes the unique East-West communications that were established here. Also in this first session, Roitburd (CSRIFM, Moscow) presented a controversial and much discussed paper on his unique "thermodynamic theory of martensite kinetics," using analytically developed analogies between stress fields (relative to the morphology of martensite plates) and magnetic fields (with respect to the size and shape of magnetic domains), as well as other comparisons. His model, although very unusual, is essentially an extension of the classical nucleation and growth theory of Kurdyumov.

## LATTICE STABILITY

The evening session on the first day was devoted to lattice stability considerations relative to martensitic transformation. E. I. Estrin (CSRIFM, Moscow) began the session by presenting extensive descriptions of the influence of the set of elastic constants. V. Krashevec (Univ. of Ljublijana, Yugoslavia) presented a very interesting lattice wave model for martensite nucleation. Although this model is admittedly based on the ideas advanced previously by Hehemann and coworkers, the paper was one of the most original and interesting contributions to this Conference. The model was fitted in this case to the fcc-to-fct martensite transformation in a non-stoichiometric Ni-rich Ni-Mn alloy, using the "composite crystallographic transformation" concept of Perkins. By this concept the lattice distortions induced by the premartensitic waves eventually trigger the usual lattice invariant deformation of martensitic transformation, with the final crystal structure being a composite, or total, of the movements of the premartensitic and martensitic stages. The work presented by Krashevec is a valuable connection of this previously incompletely-proven idea to actual microstructural data. D. F. Litvin and coworkers (CSRIFM, Moscow) cited all the ancient works on the

subject, then presented some interesting neutron-diffraction results obtained for Cu-Al-Ni single crystals. K. Enami (Osaka Univ., Japan) discussed electron microscopic and XRD studies of premartensitic observations in Ni-Al (B2) and Cu-Al-Zn (DO3) matrices, and defined the sequences of structural transitions; the temperature dependence of the elastic constants around $M_s$ was also measured and correlated with the structural observations. The ideas presented were valuable as further confirmation of the kind of model earlier presented by Krashevec.

## MECHANISMS

The morning session of the second day was titled "Thermodynamics and Structural Mechanism of Martensite Transformation." G. Thomas (Univ. of California, Berkeley) had the honor of presenting the lead paper, but had to suffer through the first half of his talk without the help of the simultaneous interpreters (who due to a mixup arrived late), with session co-chairman Utevsky serving as a rough interpreter. Fortunately, a picture is indeed worth a thousand words, and in the case of Thomas's elegant electron micrographs, probably many more. His material was new, and as usual, inspiring in its efficiency; the paper concentrated on several separate but related problems in the study of ferrous martensite:

(i) recent attempts to identify the nature of the austenite:martensite interface in 0.3%C steels, by locating retained austenite and developing lattice images across it. While this goal was not obtained in time for this meeting, one can safely assume it soon will be. Thomas showed examples of the technique, including the use of an optical Bragg diffractometer to obtain the lattice parameters of the structures on either side of the interface; he also reviewed the difficulty of detecting retained austenite by various methods;

(ii) The problem of rationalization of the observed scatter in habit plane was considered through the conception of microscopic and macroscopic habit planes, the latter consisting of a series of steps made of the former, and the size and spacing of these steps determining the observed macroscopic habit plane. Electron microscopic data were shown in support of the proposed interfacial structure;

(iii) The arrangement of "laths" in self-accommodating groups was shown by the results of tedious microstructural analyses. It was shown that in groups, which typically have about 6 units, the units actually are small plates, not truly laths, an electron microscopic confirmation of a conclusion deduced 20 years ago by light-microscopic surface relief. Each plate is rotated with respect to the others to minimize strain energy, with a thin layer of retained austenite between (which allows the orientation relationship determinations by small-area selected area electron diffraction). Thomas emphasized the pitfalls of interpreting the electron diffraction patterns from small regions such as is required

for this kind of work, and pointed out the advantage of high-voltage electron microscopy relative to resolution in the diffraction patterns. The kind of work Thomas presented is of central technological importance since, after all, the martensite packet is the basic building block of quenched steels. Also the self-accommodating plate group is a common feature between ferrous martensites and thermoelastic non-ferrous martensites (e.g., the extensive work by Delaey, Shimizu, and others).

Y. N. Petrov (IMPK) then presented his dislocation model for the nucleation of martensite. His ideas are not inconsistent with those developed by Cohen and other workers in this area, but he tends to adhere more closely to classical nucleation and growth theory (Kurdyumov). M. Cohen then considered deformation-induced nucleation of martensite, carefully distinguishing between "stress-assisted" nucleation (enhancement of the "potency" of pre-existing sites by externally imposed or internally generated elastic stresses, the latter comprising autocatalytic nucleation, so that nucleation can occur at higher temperatures than $M_s$), and "strain-induced" nucleation (slip of the parent phase takes place before nucleation of martensite, therefore providing new and more potent nucleation sites. (Note: Cohen's "stress-assisted" martensite is the same as SIM, the term used in connection with thermoelastic martensite). Whether stress-assisted or strain-induced martensitic nucleation takes place depends on whether, on increasing stress, the flow stress for SIM, or the matrix-phase yield stress, respectively, is obtained first. In general, stress-induced nucleation takes place at lower temperatures above $M_s$ than strain-induced nucleation in a given alloy. Recent results were presented showing that isothermal martensitic transformation can also be stimulated by elastic stresses, which has significance for the design of steels intended to undergo deformation-induced transformation in service. N. S. Kosenko (IMPK), coworking with A. L. Roitburd (CSRIFM, Moscow), then presented a detailed macroscopic elastic analysis for the nucleation of martensite under external stress. Discussion following this morning session centered on several key questions, one of these being the possible carbon segregation during or after formation of martensite in steels, and therefore the proper classification of the transformation.

## TRANSFORMATIONS IN ALLOYS WITH LOW STACKING FAULT ENERGY

The Tuesday-evening session was captioned: "Transformation in Alloys with Low Stacking Fault Energy." L. I. Lyssak (IMPK) presented the lead paper, reviewing the general topic area and his extensive work in this area, especially concerning the rationalization of martensitic crystallography and atom movements during the transformation; this has been a very neglected area over the years. G. Schumman (Univ. Rostok, DDR) considered the effect of external stress on the $\gamma \rightarrow \varepsilon$ transformation, making use of phenomenological theory. B. I. Nikolan (IMPK) considered the crystallography and mechanism of formation of multilayer martensite structures,

including the remarkable 126R structure discovered in Co-Ti and Co-Cu alloys. Also considered were the 9R structure (in Cu-Si, Cu-Ce, and Cu-Al alloys) and 18R structure (in Fe-Mn-C, Fe-Mn-N, and Fe-Mn-Cu alloys). A major outstanding question, of course, exists concerning the very existence of such long-period structures in metallic alloys.

## SHAPE MEMORY EFFECTS

The entire third day was dedicated to the subject area of "Shape Memory Effects and Superelasticity," which had been the focus of the 33-paper, 10-country Toronto symposium in 1975. The lead papers in this area were delivered by Khandros (IMPK), Shimizu (Osaka Univ.) and Owen (MIT). L. G. Khandros began the day with an extended review of the subject area, aided by an attention-getting Sputnik-like model which deployed mock solar-collection panels by the action of Cu-Al-Ni alloy struts which straightened when heated by passage of electric current. He presented Cu-Al-Ni alloy stress-strain data showing a sequence of plateaus, later shown conclusively by colleague Martynov, and independently by Shimizu, to be associated with a stress-dependent series of structural transitions. This behavior was first reported at the Toronto symposium by Shimizu and coworkers, and it is gradually being clarified by further studies.

K. Shimizu made a unique contribution in the form of stress-temperature "phase diagrams" derived from $\sigma - \varepsilon$ data taken at various temperatures for Cu-Al-Ni. A similar device was presented by Perkins and coworkers at the Toronto symposium (and reviewed at this Conference) in the form of three-dimensional stress-strain-temperature envelopes for Ti-Ni alloys. The development of complete thermal-mechanical data of this sort is a welcome contribution, particularly when accompanied by complete crystallographic and microstructural observations such as provided by Shimizu and coworkers. The thermal-mechanical data itself is essential to effective utilization of SME alloys in applications, while the correlated structural data are essential to understanding the behavior at a fundamental level. Shimizu's studies emphasized the behavior of Cu-Al-Ni and other alloys when deformed in the fully martensitic state, where a sequence of stress-dependent martensite transitions is seen:

$$\gamma_1'(2H) \rightarrow \beta_2'(18R) \rightarrow \alpha_1'(6R)$$

below $M_f$; other sequences are seen depending on the test temperature, and superelastic behavior is observed on stress release.

V. V. Martynov (IMPK) presented similar $\sigma - \varepsilon$ data, also for Cu-Al-Ni, and x-ray structural data for these multistage stress-dependent transitions. Shimizu, in a second paper, presented an interesting categorization of pseudoelasticities (nonlinear elasticities) separating such behavior into: (i) "superelasticity" (associated with stress-assisted austenite-to-martensite), (ii) "rubberlike behavior" (fully martensitic alloys), (iii) pseudoelasticity associated with twinning in some ordered

alloys in which the original ordered structure is destroyed by twinning, e.g., $Fe_3Be$, and (iv) "bending pseudoelasticity," a new category, associated with twin-tapering under bending stress in twinned martensitic alloys. This last effect was demonstrated by dramatic polarized-light color optical microscopy of a single variant Cu-Al-Ni $\gamma_1'$ sample, and the origin of the restoring force was proposed to be due to repulsive forces between twinning dislocations generated and piled up along the tapered twin boundaries. However, it was not proved, and seems questionable, whether the spacing between the dislocations required to develop such pileup-type forces is consistent with that required to provide the observed twin-boundary rotations. It seems more likely that some more complex type of across-twin boundary atomistic forces, such as described at the Toronto symposium by Liebermann for AuCd, may be involved.

V. N. Khachin (PHTI, Tomsk) presented some interesting x-ray and internal friction studies of TiNi that also suggested a sequence of structural transitions as a function of composition and thermomechanical treatment. Unfortunately, in view of the complexities and variety of martensite crystallographies reported over the years for TiNi, this kind of data is likely to be regarded with reservation unless exhaustively supported.

W. Owen presented a new model for growth of a thermoelastic martensitic plate, couched in terms of the strain field developed in the parent phase. This was illustrated with respect to the behavior of $Fe_3Pt$ in the ordered and disordered conditions, for which the respective yield-stress contours around plates of a given aspect ratio were compared. The ordered matrix, with yield stress about twice as high and modulus half that in the disordered condition, develops a much smaller yield-stress contour around a martensite plate than for the disordered matrix, showing that for higher ratios of yield strength to shear modulus, $\sigma_{ys}/\mu$, the possibility of irreversible slip is reduced, so that reversible thermoelastic behavior is more likely. These same views have been expressed qualitatively in the past, but the treatment presented by Owen was a useful analysis of the dependence of thermoelastic growth on certain macroscopic properties and microscopic features of the matrix phase. As pointed out in Toronto, the important aspect of matrix phase ordering, often stated in the past to be a requisite for complete SME behavior, is related more to the effect of ordering on the matrix flow stress, rather than being associated with details of the transformation mechanism; it is now clear that a disordered alloy can exhibit thermoelastic behavior and SME behavior, and that reversibility is simply more easily attained when the matrix is ordered.

H. Warlimont (Swiss Aluminum, Ltd., Switzerland) supported this, showing that small volume change and parent phase ordering are not requirements for thermoelastic behavior, but that low values of elastic shear moduli, no matter what their origin, are more fundamentally requisite to such behavior. Studies of ordered and disordered Fe-Pt alloys

indicated that although the volume change for the $\gamma \rightarrow \alpha$ transformation is large (≈0.9%), the transformation hyteresis is small (≈60°C), and magnetically induced lattice softening in disordered alloys leads to thermoelastic behavior. These observations are, of course, completely consistent with Owen's assertion that the important thing is a high value of the ratio of matrix flow stresses to shear modulus, that this ratio is greater for higher matrix strength (such induced by ordering), or for lower moduli (due to various transitions).

L. Delaey (Antwerp, Belgium), who in Toronto had presented extensive microscopic studies of beta-brass-type SME alloys, confined his contribution here to a study of the damping properties of Cu-Zn-Al martensitic alloys. This relates to one of the legitimate applications for most SME alloys, i.e., noise and vibration reduction in machinery; however, such applications require knowledge of the unique temperature and stress dependencies of the damping capacity; Delaey emphasized the importance of the latter in applications. Results were discussed for the internal friction and the noise on impact as a function of temperature, frequency, thermal cycling, and amplitude. Damping is a maximum just at the transformation temperature ($A_s$) on heating, with higher damping for higher frequencies (>2000 Hz) and at higher amplitudes. At low amplitudes, a dislocation damping mechanism, characteristic of any metallic material, is responsible for energy absorption, and the fraction of energy absorbed is low, while at higher amplitude, the movement of martensite plate boundaries is responsible for much higher damping. This behavior can be expected to be general to all martensitic SME alloys, and has been shown by other workers for TiNi, CuMn, CuAlNi, and other alloys; damping capacities of 50% and higher can be obtained.

Y. N. Koval, I. A. Arbuzova, and R. Y. Musienko (IMPK) presented their work on (partial) SME behavior in Fe-Ni and Fe-Ni-Ti alloys. (Note: Irena Arbuzova is the wife of Professor Khandros, head of the martensitic transformations group at IMPK; more than a third of the attendees at the Conference were women, a great improvement over typical metals meetings in the US, and definitely an enhancement to the dancing at the Banquet; it is not uncommon for Russian professional women to retain their own name when married.) Many of the Russian workers consider "SME" behavior to be general in all martensitic alloys, whereas complete SME is unique to thermoelastic martensitic alloys. This conception is somewhat different from the conventional view that "SME" implies complete SME and that incomplete SME should be so designated by the adjective. Discussion the afternoon of the third day, following the many papers on these thermoelastic martensitic effects, centered on the definition and meaning of "thermoelasticity"; the primary problem was obviously to rationalize the thermal effect on martensitic transformation (for which purely thermodynamic analyses apply) and the stress effect (for which the thermodynamic analyses can be and have been extended, but for which confusion arises with respect to mechanistic considerations and rationalizations with the theoretical models). Finally, after extended dialectic discussion of

the question, Cohen got up and presented a concise and simple definition of thermoelastic behavior: to paraphrase, "the concept of thermoelastic behavior can be simply characterized by a balance between the chemical driving force for martensitic transformation and purely elastic opposing forces that develop around growing martensitic plates." This statement may not have completely satisfied everyone, but does concisely suggest both the proper thermodynamic and mechanistic attitudes to the situation.

## KINETICS

G. Ansell (Rennselaer Polytechnic Institute) presented the lead paper in a half-day session on the "Kinetics of Martensite Transformations," and the Conference returned to the subject of steels. Under the hot glare of movie-camera lights and with the handicap of being the first paper the day after the banquet, Ansell showed, based on kinetic data from a series of Fe-C-Ni-Cr alloys, that the transformation rate is a function of two important factors: (i) the rate of change of the chemical driving force with temperature, $d\Delta F_c^{\gamma\rightarrow\alpha}/dT$, and (ii) the energy expended in deforming the austenite around growing martensite embryos, $\Delta F_D$. When this latter energy is used to produce additional martensite nucleii (i.e., an autocatalytic effect), as the case in the alloys studied, the transformation rate increases with both these parameters, according to a relationship of the form $\dot{g} = k(d\Delta F_c^{\gamma\rightarrow\alpha}/dT)\ (\Delta F_D)^n$. This analysis was based on the familiar model originally proposed by Magee, and the only possible flaw in its use in this case (not qualitatively ruinous to the final conclusions) is the assumption of a lath morphology when considering the strain energy around the growing martensite; it seems unlikely that the lath morphology exists in alloys with carbon contents as high as those Ansell studied in this work. V. V. Kokorin (IMPK) considered the effect of partial diffusional decomposition of the parent phase on martensitic transformation in Fe-Ni-based alloys. This is both a complex and technologically important topic, of course. Academician V. D. Sadovsky (IMPK) discussed the results of very interesting studies of the interacting effects of magnetic field and austenite grain size on martensitic transformation in steel.

## REVERSE MARTENSITIC TRANSFORMATION, MARTENSITE-TO-AUSTENITE

A full half-day was devoted to "Reverse Martensite Transformation," a topic which has importance with respect to a microstructural refinement by this means. The lead paper on this subject was delivered by Academician V. N. Gridnev, who heads a separate research section for the study of rapid heating techniques at IMPK. He remarked that whereas the past 50 years have been devoted to exhaustive studies of the austenite-to-martensite transformation, the next 50 years may be spent studying the reverse transformation. Indeed, the subject is one of increasing interest and importance, and 14 papers were contributed on the subject, all from the Soviet Union (7 different laboratories).

## POSTER REPORTS

It is not possible to review all of the more than 80 poster reports, and also not wise to try to make any general comments about their content. It can be said that they were extremely well done, and stimulated much attention and discussion. A different set of about a dozen posters was deployed at the hour break each AM and PM, with the topic of the posters corresponding to the ongoing session, and therefore were very well integrated into the program. As mentioned previously, the overall scheme for these poster sessions was the most successful anyone could recall.

## CRITICAL ANALYSIS

While this Conference must be considered a great success, even a milestone, it is still valuable to make a critical review of what its shortcomings may have been. In the area of planning and organization there were certainly none; in fact, this aspect was exceptional. From the standpoint of content, some subjects were of course underemphasized, others perhaps overemphasized, an unavoidable characteristic of all conferences, and more the fault of the contributors than the organizers. This Conference was noticeably devoid of analyses to test phenomenological theories of martensite crystallography. Also, the treatment of factors controlling the internal structure of martensite and morphology was somewhat limited. The soft-mode area lacked the contributions of a number of prominent Japanese workers. Not much hard data was added concerning the nature of martensite nucleation, and there was limited mention of isothermal martensitic transformation. Strength of martensite, a topic of much interest in the past, was virtually neglected. Similarly, thermomechanical processing and practical schemes of microstructural control via transformation were not treated in proportion to their technological importance.

What this Conference did provide that no other recent ones could have was a complete picture of activities on martensitic transformations in the Soviet Union. While these activities are obviously very widespread and extensive, and surely there is more basic work being carried out than in the US, not much applied work was evidenced. Cohen may have perceived this when, making a final statement on behalf of the "foreign guests," he sounded a warning to be sure to discriminate between the delineation of "details" and the pursuit of "essentials" when studying martensite transformations. He was careful, of course, not to specify which reports were, in his view, providing essentials versus details, since sometimes only time determines which it may be.

NOTE: INCOM

An International Committee on Martensite (INCOM) is now well-established (some of its members were annoyed at the similarity of the acronym of the Kiev conference, ICOMAT). The members of INCOM are essentially most of the major figures at the Kobe conference. The current plan is to hold INCOM conferences every two or three years. The next International Conference on Martensite will be in Boston, at MIT, in June 1979; the following one may be in Leuven, Belgium in 1982. The 1975 Toronto and 1977 Kiev meetings, and any other meetings on martensite, are apparently to be considered "extra" international conferences on martensite. Personally, it seems more appropriate simply to designate a conference by date and place only, i.e., the 1977 Kiev conference, etc., rather than by "rank" (1st, 2nd, 3rd, etc.).

# Appendix I: INTERNATIONAL CONFERENCE MARTENSITIC TRANSFORMATIONS

## programme

### May, 16

Morning session . . . . . . . . . . . . . . . . . . . 9.30—13.40

Co-chairmen: academician *G. V. Kurdyumov*,
academician AS UkrSSR *V. N. Gridnev*

The word of introduction by academician AS UrkSSR *V. N. Gridnev*

1. 50 years of the martensite transformation investigations in the Soviet Union. Yu. A. Osipyan (IFSS, Moscow). 40 min.
2. On the tetragonality of martensite. Academician G. V. Kurdyumov. 20 min.
3. Some recent researches of the martensite transformation in Japan. Z. Nishiyama (Fundamental research laboratories, Nippon Steel Corporation, Ida, Japan). 20 min.

4. Martensite transformations and the classical theory of phase transformations. A. L. Roitburd (CSRIFM, Moscow). 20 min.

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POSTER REPORTS

5. Effect of the austenite structural state on the martensite transformation in Fe—Ni—Ti alloy. S. P. Kondratyev, L. I. Lyssak, V. S. Tatarchuk (IMPh, Kiev).
6. $\varkappa'$—martensite and $\varkappa' \to \alpha_m$ transition in the aluminium steel. N. A. Storchak, A. G. Drachinskaya (IMPh, Kiev).
7. Peculiarities of the martensite transformation in the annealed high-carbon manganese steels. L. O. Andruschik (IMPh, Kiev).
8. Specific states of the martensite containing irradiation defects. V. K. Kritskaya (CSRIFM, Moscow).
9. Mössbauer effect in the martensite of Fe—Mn—C and Fe—Ni—C alloys. V. G. Gavrilyuk, V. M. Nadutov, O. N. Razumov (IMPh, Kiev).
10. Carbon redistribution in submicrovolumes in the steel. Yu. L. Rodionov, P. L. Gruzin, G. G. Isfandiyarov (CSRIFM, Moscow).
11. Crystal structure peculiarities of austenite and martensite in quenched steels. Yu. D. Tyapkin, A. A. Gulyaev, I. Ya. Georgieva (CSRIFM, Moscow).

12. Lattice change at the first stage tempering of carbon martensite. M. A. Bernshtein, M. A. Shtremel, L. M. Kaputkina, S. D. Prokoshkin (MISA, Moscow).
13. The role of carbon in formation of the mechanical properties of Fe—Ni—C martensite. Yu. I. Kogan, G. V. Angelova (PhTI, Tomsk).
14. Thermal stabilization of austenite heterogenized by the products of its stable decomposition. V. N. Gridnev, Yu. N. Garassim, S. P. Oshkaderov (IMPh, Kiev).
15. Structural peculiarities of the martensite transformation in aluminium steel. A. V. Suyazov, M. P. Usikov (CSRIFM, Moscow).
16. Effect of the structure state of the deformed austenite on the morphology and composition of the thermomechanically hardened martensite in steels. M. L. Bernshtein, L. M. Kaputkina, S. D. Prokoshkin, A. M. Glushits (MISA, Moscow).
17. Theoretical investigation of kinetics of the redistribution processes of the interstitial atoms among interstices of different kinds in metals and alloys. V. N. Bugaev, Z. A. Matisina, V. I. Rizhkov, A. A. Smirnov (IMPh, Kiev).

Evening session . . . . . . . . . . . . . . . . 15.00—19.00

Co-chairmen: *E. I. Estrin* (CSRIFM, Moscow)
*H. Warlimont* (Swiss Aluminium Ltd., Switzerland).

1. Lattice stability and martensite transformations. E. I. Estrin (CSRIFM, Moscow). 20 min.
2. On the nucleation of martensite in Ni-rich Ni—Mn alloy. V. Krashevec (University of Ljubljana, Ljubljana, Yugoslavia). 20 min.
3. On peculiarities of the crystal lattice stability loss in alloys. D. F. Litvin, O. N. Efimovich, E. Z. Vintaikin, S. P. Solov'ev, V. G. Shapiro (CSRIFM, Moscow). 15 min.

4. Investigation of lattice instability of metal alloys in a premartensitic state. B. S. Bokshtein, S. Z. Bokshtein, L. M. Klinger, I. M. Razumovsky (MISA, UIAM, Moscow). 15 min.
5. Martensitic precursors in Ni—Al and Cu—Al—Zn alloys. K. Enami, A. Nagasawa, J. Matsumoto, S. Nenno (Universities, Japan). 15 min.
6. Elastic properties and quasistatic shifts of atoms near the martensite transformation point. V. V. Kondrat'ev, Yu. D. Tyapkin (IMPh, Sverdlovsk; CSRIFM, Moscow). 15 min.
7. Investigation of the instability state of martensite and austenite lattice in Fe—Ni alloys at direct and reverse martensite transformation. E. E. Yurchikov (IMPh, Sverdlovsk). 15 min.

## POSTER REPORTS

8. Investigation of crystal lattice of Fe—Mn and Fe—Ni martensite alloys. G. A. Charushnikova, L. D. Chumakova (UPI, Sverdlovsk).
9. The structure peculiarities of martensite crystals in quenched steel. M. P. Arbuzov, A. S. Parobets, V. M. Cherkassky (IPMS, Kiev).
10. Martensite transformations and interstitial atoms ordering in solid solutions on the base of metals of V group. B. V. Khaenko (IMPS, Kiev).
11. Crystallographical analysis of premartensite state (the state of uncomplished shift) at lattice reconstruction fcc ← hcp and fcc ↓ bcc. T. V. Schegoleva (IMPh, Sverdlovsk).
12. Change of the mechanism of martensite transformation microkinetics and premartensite state in Fe—Ni alloys. V. L. Snezhnoy, V. T. Totsky (ZPI, Zaporozh'e).
13. X—ray investigation of a premartensite state of fcc lattice in metals and alloys. V. M. Ershov (MMI, Kommunarsk).
14. Premartensite instability in Fe—Ni alloys. V. G. Pushin, R. R. Romanova, N. N. Buinov (IMPh, Sverdlovsk).
15. Austenite mechanical instability in premartensite state. S. O. Suvorova (CSRIFM, Moscow).
16. Diffuse scattering preceding the formation of $Nb_3Al$ phase in Nb—20 at.%Al alloy and its relation to the lattice instable state. S. V. Sudareva, E. P. Romanov, A. F. Prekul, E. H. Juravleva (IMPh, Sverdlovsk).
17. Atomic long—range order and the crystal lattice stability to fcc ⇄ bcc transformation in CuPd alloy. E. V. Kozlov, A. A. Klopotov, A. S. Tailashev (ISI, Tomsk).
18. Premartensite state investigation using the orientation effects during the interaction of charged particles with single crystals. V. P. Korobeinikov, I. N. Bogachev, B. N. P'yankov (UPI, Sverdlovsk).
19. Investigation of the lattice premartensite instability by the stress relaxation method. S. L. Kuz'min, V. A. Likhachev, P. A. Nesterov, Yu. A. Nikonov, O. G. Sokolov, E. E. Shereshevskaya (LSU, Leningrad).

## May, 17

Morning session . . . . . . . . . . . . . . . . 9.00—13.30

## THERMODYNAMICS AND STRUCTURAL MECHANISM OF MARTENSITE TRANSFORMATIONS

Co-chairmen: *L. M. Utevsky* (CSRIFM, Moscow)
*G. Thomas* (University of California, USA)

1. Investigation of martensite in steel by the method of electron microscopy with high resolution. G. Thomas (University of California, USA). 20 min.
2. On the dislocational nucleation of martensite in steel. Yu. N. Petrov (IMPh, Kiev). 15 min.
3. Deformation-induced nucleation of martensitic transformation. M. Cohen (Massachusetts, USA). 20 min.
4. External stress effect on thermodynamics and structure of martensite transformation products. N. S. Kosenko, A. L. Roitburd (IMPh, Kiev; CSRIFM, Moscow). 15 min. Roitburd
5. Crystallography of the martensite transformation at small plastic deformations in tension and compression. M. N. Pankova, L. M. Utevsky (CSRIFM, Moscow). 15 min.
6. Atomic interaction and driving force of martensite transformations in alloys. V. E. Panin, A. I. Lotkov, A. V. Kolubaev, I. I. Naumov, M. F. Jorovkov (PhTI, Tomsk). 20 min.
7. Martensite transformation in Ni—Al system and effect of Si and Co. V. S. Litvinov, A. A. Arkhangelskaya (UPI, Sverdlovsk). 15 min.

## POSTER REPORTS

8. ε′—martensite in carbonless Mn—Cu alloys. B. I. Nikolin, Yu. N. Makogon (IMPh, Kiev).
9. Structure irreversible martensite transformations in borone nitride. A. V. Kurdyumov, A. N. Pilyankevich, I. N. Frantsevich (IPMS, Kiev).
10. Morphology of the packet martensite in pseudo single crystals. M. A. Shtremel, Yu. G. Andreev, L. N. Devchenko, E. V. Shelekhov (MISA, Moscow).
11. The structure of martensite packet in iron—base alloys. V. M. Stchastlivtsev (IMPh, Sverdlovsk).
12. Magnetic permeability disaccomodation in iron—carbon martensite. J. Ilczuk, J. Moron, J. Przybyla (IPhChM, Katowice, Poland).
13. Nucleation of partial dislocations (twinning and those of transformation) and atomic relaxation at coherent boundaries. V. Z. Bengus, S. N. Komnik, V. I. Startsev (PhTILT, Kharkov).
14. Martensite transformation and its effect on physico-mechanical properties of stainless alloys single crystals. L. V. Skibina, V. Ya. Il'ichev (PhTILT, Kharkov).
15. Dislocation models in the martensite transformation theory. V. A. Solov'ev (CSRIFM, Moscow).
16. On the nature of microdefects at the martensite transformation. V. I. Sarrak, G. A. Filippov (CSRIFM, Moscow).
17. "Inheritance" of dispersed particles from austenite by martensite and its peculiarities. V. I. Izotov (CSRIFM, Moscow).
18. Capabilities of emission for the study of structural and kinetic peculiarities of $\gamma \rightleftarrows \alpha$ martensite transformation in iron—base alloys. R. I. Mintz, V. G. Gorbach, I. Yu. Ievlev, V. V. Bukhalenkov, Yu. L. Chepelev (UPI, Sverdlovsk; IMPh, Kiev).
19. The effect of magnetic field while quenching on mechanical properties of steels. V. D. Sadovsky, L. V. Smirnov, V. N. Olesov, E. A. Fokina (IMPh, Sverdlovsk).
20. Martensite structures of moon iron. R. I. Mintz, T. M. Petukhova, V. P. Shaldibin (UPI, Sverdlovsk).

<u>Evening session</u> . . . . . . . . . . . . . . . . . 15.00—19.00

## TRANSFORMATIONS IN ALLOYS WITH LOW STACKING FAULT ENERGY

Co-chairmen: *L. I. Lyssak* (IMPh, Kiev)
*G. Schumann* (University, Rostok, DDR).

1. Martensite transformations in alloys with low stacking fault energy. L. I. Lyssak (IMPh, Kiev). 20 min.
2. Effect of the external stress on martensite $\gamma \rightarrow \varepsilon$ transformation. G. Schumann (University, Rostok, DDR). 15 min.
3. Crystal structure and principle of formation of multi-layer martensite structures. B. I. Nikolin (IMPh, Kiev). 15 min.
4. Formation of close-packed martensite structures in Cu—Si alloys. A. I. Ustinov, L. I. Lyssak (IMPh, Kiev). 15 min.
5. Formation of intermediate phase at $\alpha \rightleftarrows \gamma$ transformation in iron and iron—base carbon steels. V. V. Burdin, V. N. Minakov, V. I. Trefilov, S. A. Firstov (IMPh; IPMS, Kiev). 15 min.
6. *Stacking fault energy and strain-induced martensite in the* austenite steels. N. I. Noskova, K. A. Malyshev (IMPh, Sverdlovsk). 15 min.
7. Phase transformations in Fe—Mn alloys under load. L. S. Malinov (MI, Jdanov). 15 min.

## POSTER REPORTS

8. Hysteresis of low-temperature transformations under pressure. M. I. Turchinskaya, T. M. Turusbekov, Yu. L. Alshevsky, E. I. Estrin (CSRIFM; IPhSS, Moscow).
9. Macro- and microkinetics of martensite transformation. L. G. Juravlev, M. M. Shteinberg (UPI, Chelyabinsk).
10. Formation peculiarities of {110} <011> twins of α-martensite in steel. Yu. M. Polischuk, V. E. Danilchenko, A. I. Ustinov (IMPh, Kiev).
11. Changes in the X—ray emission spectra of valence electrons during martensite transformation in Fe—Ni alloy. A. I. Zakharov, Yu. A. Matveev, K. V. Trush (CSRIFM, Moscow).
12. Mechanism of additional shift formation and the morphology of martensite crystals in Fe—31Ni alloy. A. G. Yakhontov, S. S. Mischenko, L. A. Melnikov (KSU, Frunze).
13. The nature of dilatometric anomaly in cold-worked foil of Fe—Cr—Ni alloys. S. A. Lur'e, O. V. Basargin, A. I. Radkov, N. A. Makushin, N. N. Potapov, B. A. Kornienkov (CSRIFM, Moscow).
14. The martensite transformations in trip-steel during fast deformation and aging. B. G. Tugelbaeva, T. P. Yakhontova, M. A. Nogaev, N. E. Bakhareva, V. A. Salaev (KSU, Frunze).

15. The martensite transformations under load and mechanical properties of Fe—Ni alloys. A. I. Uvarov (IMPh, Sverdlovsk).
16. Effect of martensite transformation on plastic deformation of Fe—Ni—C alloy. M. Yakeshova, I. Mrovets (IMPh, Brno; SRIFM, Dobra, ChSSR).
17. The martensite transformations during low temperature thermocycles and peculiarities of its effect on the yield strength of 03X18H8 and 0X18H10T steels. E. M. Medvedev, F. F. Lavrentiev, T. M. Kurmanova (PhTILT, Kharkov).
18. Formation of strain-induced martensite under high hydrostatic pressure. V. I. Zaitsev, A. S. Domareva (PhTI, Donetsk).

## May, 18

Morning session . . . . . . . . . . . . . . . . . 9.00—13.30

### SUPERELASTICITY, SHAPE MEMORY EFFECT.

Co-chairmen: *L. G. Khandros* (IMPh, Kiev)
*L. Delaey* (University, Lion, Belgium)

1. Superelasticity and shape memory effect. L. G. Khandros (IMPh, Kiev). 20 min.
2. Multistage superelasticities associated with successive stress-induced transformation. K. Shimizu (Osaka University, Japan). 20 min.
3. A number of martensitic phases in Cu—Al—Ni single crystals caused by deformation. V. V. Martynov, L. G. Khandros (IMPh, Kiev). 15 min.
4. Pseudoelasticity associated with twin boundary movements in single variant twinned martensites. K. Otsuka, G. Sakamoto, K. Shimizu (Osaka University, Japan). 15 min.
5. Shape memory effect associated with strain-reversible martensitic deformation: correlation of structural features and mechanical behavior. J. Perkins (Naval Postgraduate School, California, USA). 15 min.
6. Martensite transformations and shape memory effects in Ti—Ni-base alloys (I). L. A. Monasevich, V. E. Gyunter, V. N. Khachin, Yu. I. Paskal (PhTI, Tomsk). 15 min.
7. Unelastic properties of TiNi alloy before and during the martensite transformation. G. Guenin, M. Morin, P. Gobin (INSA, Lion, France). 15 min.

### POSTER REPORTS

8. Martensitic and antiferromagnetic structural transformations in Au—Mn alloys. R. Müller, H. Warlimont (M. Plank Inst., Studtgardt, BRD; Aluminium Ltd., Switzerland).
9. Martensite transformations and shape memory effects in Ti—Ni-base alloys (II). V. N. Khachin, Yu. I. Paskal (PhTI, Tomsk).
10. Magnetic nature of fcc—fct martensite transformation in alloys on γ—Mn base. V. A. Udovenko, E. Z. Vintaikin, V. M. Sakhno, L. D. Gogua (CSRIFM, Moscow).
11. Displacive transformations in Fe—Si—C alloys upon quenching from a liquid state. Yu. A. Skakov, N. V. Edneral, V. A. Lyakishev (MISA, Moscow).
12. Laser model of martensite transformation in transition metal alloys. M. P. Kaschenko (UPI, Sverdlovsk).
13. Polymorphic transformations associated with the magnetic phase transitions. A. I. Mitsek, I. N. Karnaukhov (IMPh, Kiev).
14. Cinematographic study of polymorphic transition on transparent crystals. E. V. Safonov, A. V. Shalimova (CSRIFM, Moscow).
15. On the steps of $\gamma \rightarrow \alpha$ transformation in iron—base alloys under the cooling at $4 \cdot 10^5$ °/sec rate. D. A. Mirzaev, T. N. Ponomareva, M. M. Steinberg (UPI, Chelyabinsk).
16. On thermal treatment dependence of the shape memory effect in Ni—Ti alloys. Yu. N. Koval, V. I. Kolomytsev, V. A. Lobodyuk, V. V. Martynov, L. G. Khandros (IMPh, Kiev).

Evening session . . . . . . . . . . . . . . . . 15.00—19.00

### SUPERELASTICITY, SHAPE MEMORY EFFECT.

Co-chairmen: *E. Z. Vintaikin* (CSRIFM, Moscow)
*K. Shimizu* (Osaka, University, Japan)

1. The mechanics and thermodynamics of thermoelastic growth. W. Owen (Massachusetts Institute of Technology, USA). 20 min.
2. Ferroelasticity and "memory" effects in thermoelastic martensites. D. Lieberman (University of Illinois, USA). 15 min.

3. Magnetoelastic effects and pseudoelastic martensitic transformation in Fe—Pt alloys near $Fe_3Pt$. G. Hausch, E. Török, H. Warlimont (Swiss Alum. Ltd., Institute Dr. Ing. R. Straumann A. G., Switzerland). 15 min.
4. The damping capacity of Cu—Zn—Al martensitic alloys. W. Dejonghe, R. De Batist, L. Delaey (Univ. Leuven, Belgium; Univ. Rio Grande, Brasil; Antwerpen, Belgium). 15 min.
5. Structural mechanism of a reversible shape change in Mn—base alloys. V. A. Udovenko, D. F. Litvin, S. Yu. Makushev (CSRIFM, Moscow). 15 min.
6. The shape memory effect and the temperature interval of a reverse martensite transformation in Fe—Ni and Fe—Ni—Ti alloys. I. A. Arbuzova, Yu. N. Koval, R. Ya. Musienko (IMPh, Kiev). 15 min.
7. The influence of thermal treatment on structural changes and the shape memory effect in Cu—Al—Ni and Cu—Sn alloys. V. A. Lobodyuk, V. K. Tkachuk (IMPh, Kiev). 15 min.
8. Thermoelastic martensite transformation in Fe—Ni alloys with mechanical memory. I. M. Sharshakov V. S. Postnikov, A. A. Kolyada, N. M. Matveeva (VPI, Voronezh; IM, Moscow). 15 min.

Discussion . . . . . . . . . . . . . . . . . . 18.30—19.00

POSTER REPORTS

9. The kinetics peculiarities of $\gamma \rightarrow \varepsilon$ transformation in the 18—10 stainless steel. L. N. Larikov, G. A. Takzei, O. A. Shmatko (IMPh, Kiev).
10. The influence of the plastic deformation on the structure and shape memory effect in the titanium nickelide base alloys. N. F. Zhebyneva, S. V. Oleinikova, I. I. Kornilov (IM, UILA, Moscow).
11. Structural changes in martensite of Cu—base alloys possessing the shape memory under external stresses. I. M. Sharshakov, N. V. Agapitova, V. A. Evsyukov, L. V. Nikiforova (VPI, Voronezh)
12. Cyclic hardening of metals possessing the mechanical memory. R. A. Arutyunyan, S. L. Kuz'min, V. A. Likhatchev (LSU, Leningrad).
13. Superelasticity and shape memory effects in metals and alloys under twisting. Z. P. Kamentseva, S. L. Kuz'min, V. A. Likhatchev, M. V. Masterova (LSU, Leningrad).
14. Peculiarities of strain memory in tinned brass LO60-1. L. G. Beizina, A. A. Presnyakov (INPh, Alma-Ata).
15. The effect of partial decomposition of $\beta_1$—phase on the martensite transformation in Cu—Al—Mn alloy. T. L. Dobrovolskaya, P. V. Titov, L. G. Khandros (IMPh, Kiev).
16. Martensite transformations in Fe—Mn alloys. M. A. Filippov, M. S. Khaduev (UPI, Sverdlovsk).

**May, 19**

Morning session . . . . . . . . . . . . . . . . . 9.00—13.30

**KINETICS OF MARTENSITE TRANSFORMATIONS**

Co-chairmen: *A. L. Roitburd* (CSRIFM, Moscow)
*M. Cohen* (Technological Institute, Massachusetts, USA)

1. Kinetics of the martensite transformation in athermal Fe—C—Ni—Cr alloys. G. Ansell, K. Pradhan (Polytechnical Inst., New York, USA). 15 min.
2. Isothermal and athermal martensite $\gamma \rightarrow \alpha$ transformations in iron-base alloys. I. Ya. Georgieva, I. I. Nikitina (CSRIFM, Moscow). 15 min.
3. Contribution to the study of dynamics of martensite phase transformations. P. Pahuta, L. Hyspecka, K. Mazanec (RIVS; University, Ostrava, ChSSR). 15 min.
4. Peculiarities of diffusionless transformation kinetics in alloys. D. E. Temkin (CSRIFM, Moscow). 15 min.
5. Martensite transformations in continuously decomposed solid solutions. V. V. Kokorin, K. V. Chuistov (IMPh, Kiev). 15 min.
6. Magnetic field effect on martensite transformation in the steel with different austenite grain size. V. D. Sadovsky, E. A. Fokina, L. V. Smirnov, V. N. Olesov (IMPh, Sverdlovsk). 15 min.
7. New data on martensite—like transformations in steel. L. I. Kogan, A. G. Kozlova, N. A. Smirenskaya, M. P. Usikov, R. I. Entin (CSRIFM, Moscow). 15 min.
8. On the nucleation of martensite in iron alloys. K. E. Esterling (University, Lulea, Sweden). 15 min.
9. On the role of austenite grain size in martensite transformations at cooling and deformation. O. P. Maksimova, V. N. Zambrzhitsky, I. Yu. Panarina (CSRIFM, Moscow). 15 min.

POSTER REPORTS

10. Austenite inhomogeneity and its effect on martensite transformation. A. S. Zavyalov (SZPI, Leningrad).
11. Martensite formation kinetics at cyclic deformation. Yu. A. Avetisyan, P. Yu. Volosevich, Yu. I. Samsonov (IMPh, Kiev).
12. Specific features of martensite transformations in crystalline polymers and the role of crystallographical defects in the transformation mechanism. A. P. Dreimanis (IMP, Riga).
13. Peculiarities of direct and reverse $\gamma \rightleftarrows \alpha$ transformation in aging Fe—Ni—Ti alloys. N. D. Zemtsova, K. A. Malyshev (IMPh, Sverdlovsk).
14. Reverse martensite transformation in the BHC—2U steel. E. S. Machnev, T. M. Gapeka (MP, Verchnesaldinsk).
15. The use of Mössbauer effect for the study of reverse martensite transformation mechanism in Fe—Ni alloy. V. A. Shabashov, V. V. Sagaradze, E. E. Yurchikov (IMPh, Sverdlovsk).
16. Influence of structural defects on the processes of short-range and martensite transformations in the Fe—Ni base alloys. P. L. Grusin, Yu. L. Rodionov, V. N. Zambrzhitsky, O. P. Maksimova, O. S. Sarsenbin (CSRIFM, Moscow).

Evening session . . . . . . . . . . . . . . . . . . 15.00—18.30

**REVERSE MARTENSITE TRANSFORMATION**

Co-chairmen: academician *V. D. Sadovsky*
academician *V. N. Gridnev*

1. Mechanism and kinetics of phase transformations during fast heating. V. N. Gridnev (IMPh, Kiev). 20 min.
2. Reverse transformations in Fe—(0—32)%Ni alloys. V. M. Kardonsky. T. V. Roschina (CSRIFM, Moscow). 15 min.
3. Structural kinds of $\gamma$—phase in alloys with the reverse martensite transformation. V. V. Sagaradze (IMPh, Sverdlovsk). 15 min.
4. Transmission electron microscopy investigation of structural mechanism of the reverse transformation in alloyed steels. N. V. Koptseva, V. M. Schatlivtsev (IMPh, Sverdlovsk). 15 min.
5. Morphology of austenite formed at heating of the steel with initial martensite structure. V. M. Umova, V. D. Sadovsky (IMPh, Sverdlovsk). 15 min.

*Discussion*

POSTER REPORTS

6. Peculiarities of direct and reverse martensite transformation in two-phase Ti—base alloys. M. A. D'yakova, E. A. Lvova (UPI, Sverdlovsk).
7. Vacancy concentration growth at the reverse martensite transformation in Fe—Ni—Ti alloy. V. A. Teplov (IMPh, Sverdlovsk).
8. Morphology and crystallography of transformed austenite in Fe—Ni base alloys. E. A. Izmailov, V. G. Gorbach (KSU, Frunze; IMPh, Kiev).
9. Reversible anisotropic size change at successive $\gamma \rightarrow \alpha$ and $\alpha \rightarrow \gamma$ transformations in deformed single crystals of Fe—Ni alloy. V. I. Zeldovich, O. S. Shadrina, I. P. Sorokin (IMPh, Sverdlovsk).
10. Reverse martensite transformation at low—temperature tempering of quenched titanium alloys. V. S. Tomsinsky, A. S. Ivanov (PPI, Perm').
11. Martensite deformation effect on $\gamma$—phase orientation during reverse martensite transformation. I. P. Sorokin, E. V. Agapova (IMPh, Sverdlovsk).
12. Structural mechanism of the reverse $\alpha \rightarrow \gamma$ transformation in Fe—Ni and Fe—Co—Ni alloys with lenticular martensite. V. I. Zeldovich, E. S. Samoilova, O. S. Shadrina (IMPh, Sverdlovsk).
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Adoption of the resolution

CLOSING CEREMONY

Appendix II: Guide to Abbreviations of the Titles of Russian Research Laboratories

AS UKr SSR: Academy of Sciences, Ukrainian S.S.R. (Kiev)

IMPh: Institute of Metal Physics (Kiev, Sverdlovsk, etc.)

IPMS: Institute of Problems of Materials Science (Kiev)

CSRIFM: Central Research Institute of Ferrous Metallurgy (Moscow)

MISA: Moscow Institute of Steel and Alloys

IPhSS, IFSS: Institute of Physics of the Solid State (Moscow)

UIAM: All-Union Institute of Aviation Engineering (Moscow)

ZPI: Zaporozh'e Polytechnic Institute

VPI: Voronezh Polytechnic Institute

LSU: Leningrad State University

PhTILT: Physicotechnical Institute of Low Temperature (Khaskov)

UPI: Urals Polytechnic Institute (Sverdlovsk, Chelyabinsk)

PhTI: Physicotechnical Institute (Tomsk)

UILA: All-Union Institute of Light Alloys (Moscow)

PPI: Perm Polytechnic Institute (Perm')